

AS/400 ImagePlus system view

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Storage space, loss of documents, misfiled and misplaced documents, and document retrieval are just a few of the problems of processing large volumes of paper. High storage costs, lost productivity, personnel costs, and poor responsiveness are some of the results. Until recently, technology could not provide a cost-effective method for reducing this paper flow. IBM designed its midrange ImagePlus™ system to provide an effective and comprehensive solution to both the paper and the work-flow problems. The AS/400™ ImagePlus system provides an imaging environment for departmental installations of up to 256 workstations. This system combines the image-handling capabilities of the IBM ImagePlus Workstation Program, the user interface and case/folder processing of the AS/400 Workfolder Application Facility, with the image storage and retrieval capabilities of the optical storage support subsystem. All together, these facilities provide a highly configurable system capable of handling high volumes of transactions.

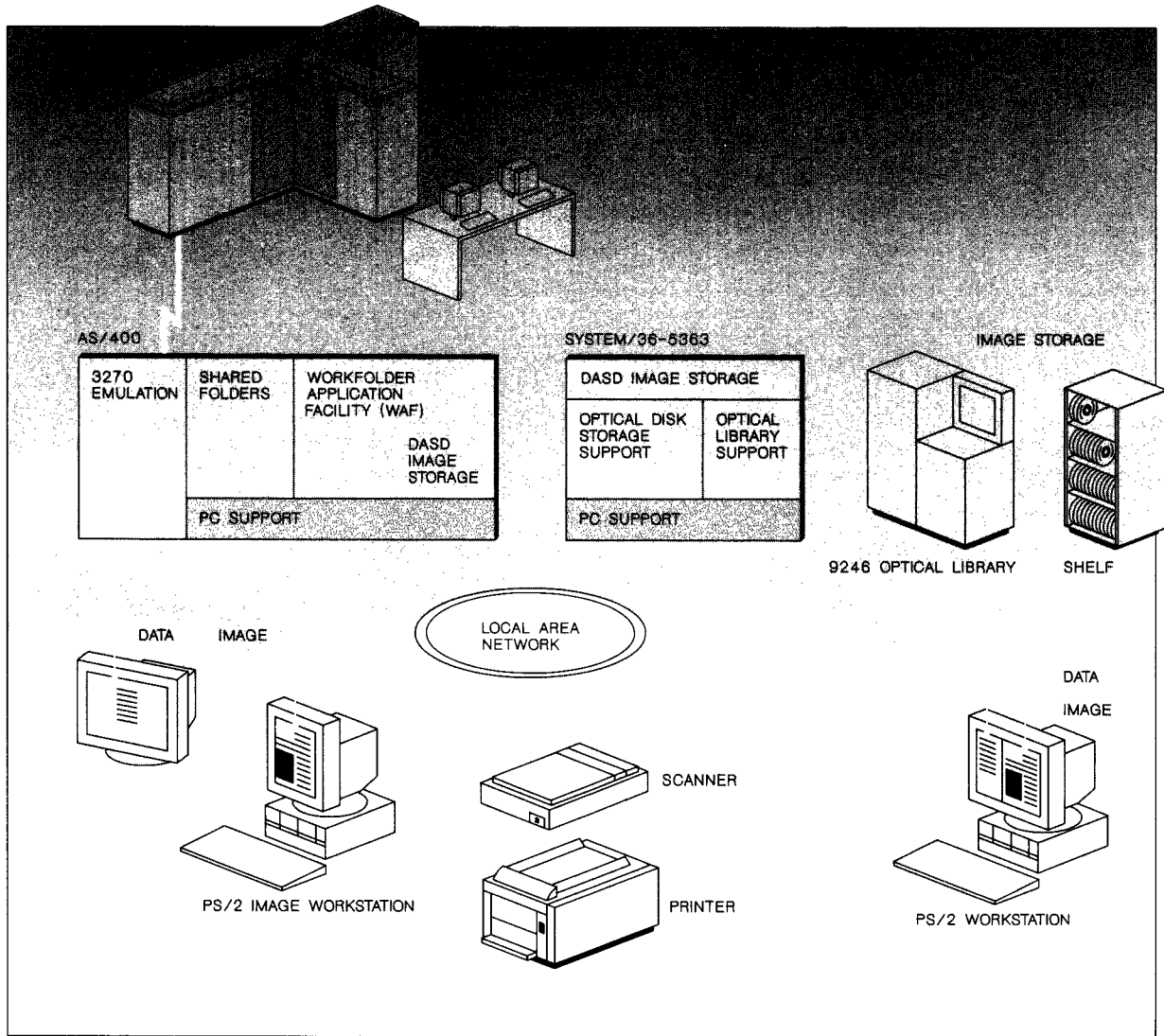
The AS/400™ ImagePlus™ system was designed to integrate image with existing applications, thereby providing a separate subsystem or system for image handling. This allows the current application to be capable of processing images without major modifications. AS/400 ImagePlus uses standard IBM products across standard interfaces and architectures, and isolates the application from the devices and media that are required for image handling. Working in partnership with key customers, we took a market-driven approach to this problem in which we developed a prototype that delivered a product for a specific set of customer requirements much faster than would top-down development. Continued participation with the marketplace to refine the product allows us to address the needs of an ever-increasing number of customers.

AS/400 ImagePlus hardware configuration

Figure 1 shows a typical AS/400 ImagePlus configuration. The AS/400 system may be any of the available models, depending on the customer environment. The Workfolder Application Facility (WAF), runs in the AS/400, and the images are initially stored on the AS/400 DASD, using the AS/400 PC Support shared folders facility. Images may be migrated to optical disk storage via a background process that may be initiated at any time. The workstation, a PS/2 Model 50 or higher with the IBM image adapter card, provides the ability to retrieve and display images stored on either AS/400 DASD or optical media. With the addition of a daughter card that attaches directly to the image adapter card, the workstation may perform scanning and printing. All functions may be performed at a single workstation, but scanning and printing are typically performed on dedicated workstations. The scanning may be done on a Bell and Howell Corporation COPISCAN I™ or COPISCAN II™ scanner, or an IBM 3117 or IBM 3118 scanner. Scanning speeds up to one page per second are possible in the ImagePlus environment. The printers used are the IBM 4216 Pageprinter or the IBM 3812. An ImagePlus system is capable of printing images at speeds of up to ten pages per minute. The other major component, the Optical Storage Support Subsystem, includes the System/36 Model 5363 attached

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Figure 1 AS/400 ImagePlus configuration



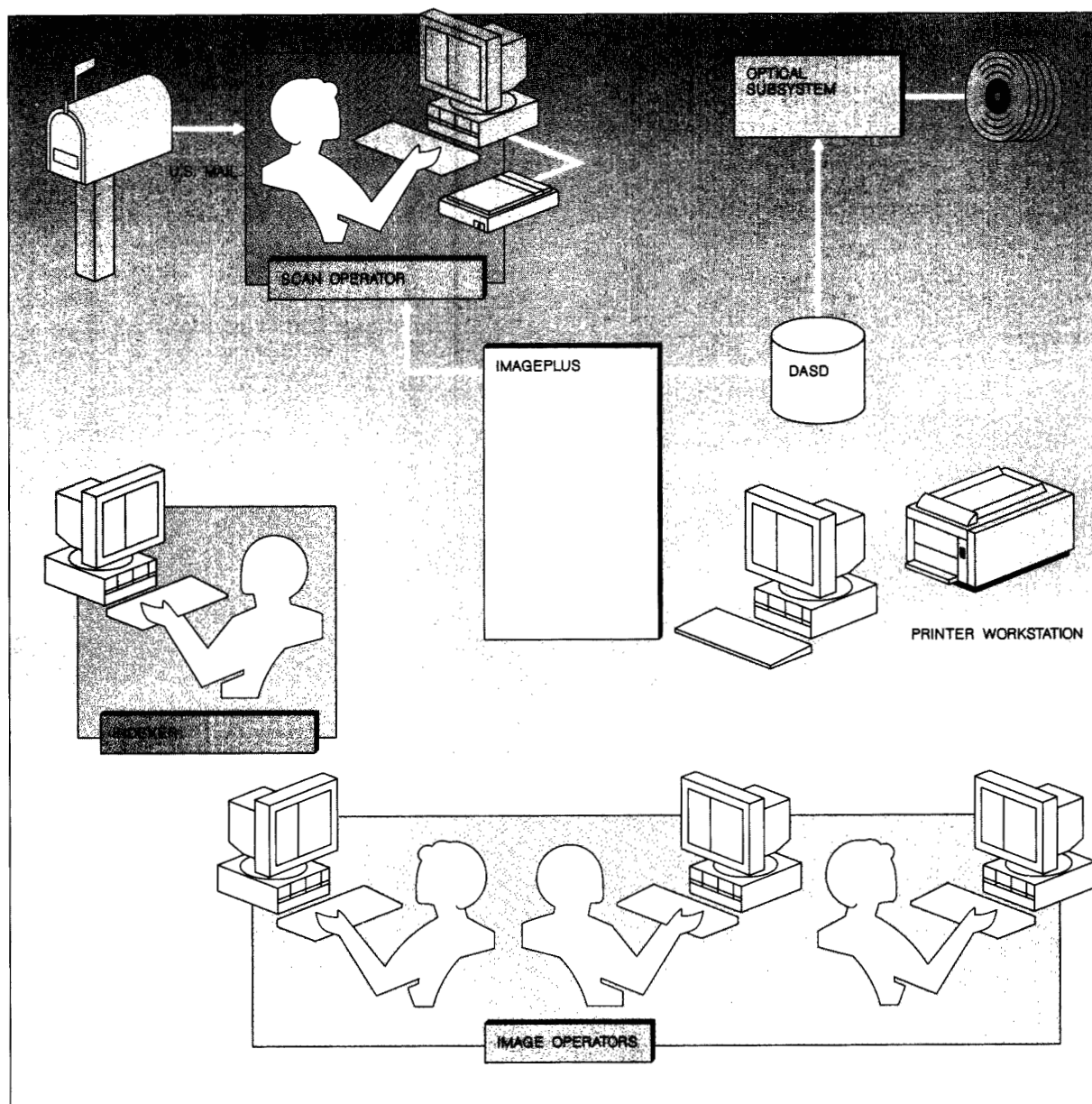
to an IBM 9246 optical library and/or IBM 9247 stand-alone optical drives. The System/36 Model 5363 serves as the optical controller. All components are connected via the IBM Token-Ring Network. Workstations communicate with the AS/400 PC Support and workstation function products. Configurations utilizing multiple AS/400 processors are possible. Multiple optical processors are also an option. The complete configuration may have as many as six processors. For example, a large AS/400 ImagePlus configuration could have two AS/400s and four Optical Storage Support Subsystems.

AS/400 ImagePlus operational concepts

Figure 2 shows a high-level view of an ImagePlus operational environment. The scanner operator receives paper documents from the mailroom in batches of similar types of mail. This operator selects scanning via the Workfolder Application Facility (WAF) menus and operates the scanner to scan and verify the document.

An indexing operation may be performed separately or in conjunction with scanning. This operation

Figure 2 AS/400 ImagePlus operational concept



creates a new case, i.e., logical collection of documents, for the document or matches the document with an existing case.

Image operators select a case, view the documents, and access existing line-of-business (LOB) applications to perform whatever operation is necessary to

complete the transaction. In performing the transaction, the image operator may close a case, reassign it, or suspend it while waiting for further information or some event to occur.

Scanned documents are initially stored on the AS/400 DASD. An asynchronous operation is initiated to

place a copy of the image on optical storage. The DASD copy may be erased when the case is closed or suspended, leaving only the optical copy, which may be staged for retrieval to support further processing.

AS/400 ImagePlus processing

Figure 3 shows a high-level view of the interaction between the major components of the AS/400 ImagePlus system. We now discuss the key elements of ImagePlus processing.

Workfolder Application Facility. The Workfolder Application Facility (WAF) provides the case/folder application interface with the end user. It also provides a menu-driven interface and sends commands to the image workstation to initiate the scanning, printing, or display of a document. The WAF interfaces with the Optical Storage Support Subsystem to cause the storage and retrieval of images. WAF is discussed in more detail in the following main section.

ImagePlus Workstation Program. The ImagePlus Workstation Program is discussed in detail in Reference 1. This program interfaces with the scanning, printing, and display hardware.

Scanning is the process of converting a paper document into a raster image and is performed at a workstation with one of the three types of scanners attached. This workstation requires an image adapter card, as required at all image workstations, plus a daughter card to provide scanning capability. Documents are scanned at 200 or 240 picture elements (pel) per square inch and displayed at 100 picture elements (pel) per square inch at the image workstation. Images are compressed, using a Modified Modified READ (MMR) or International Telegraph and Telephone Consultative Committee (CCITT) Group 4 compression algorithm. They are then converted into the IBM Image Object Content Architecture (IOCA) format, wrapped in a Mixed Object Document Content Architecture (MO:DCA) envelope, and stored on AS/400 DASD. Documents may consist of one or more pages. As each page is scanned, it is displayed for quality checking. Pages may be rejected and rescanned after adjusting the contrast and intensity controls on the scanner. After all the pages of a document have been scanned, the operator accepts the document by pressing the Enter key, and the document is stored on the AS/400 system using the PC Support shared folders.

Printing documents is performed at workstations, with one of the supported printers directly attached to the image adapter. This process also requires the special daughter card. Documents may be printed individually or as part of a case. The ability to merge coded data, stored in Presentation Text Object Content Architecture (PTOCA) format, with an image for printing is also provided.

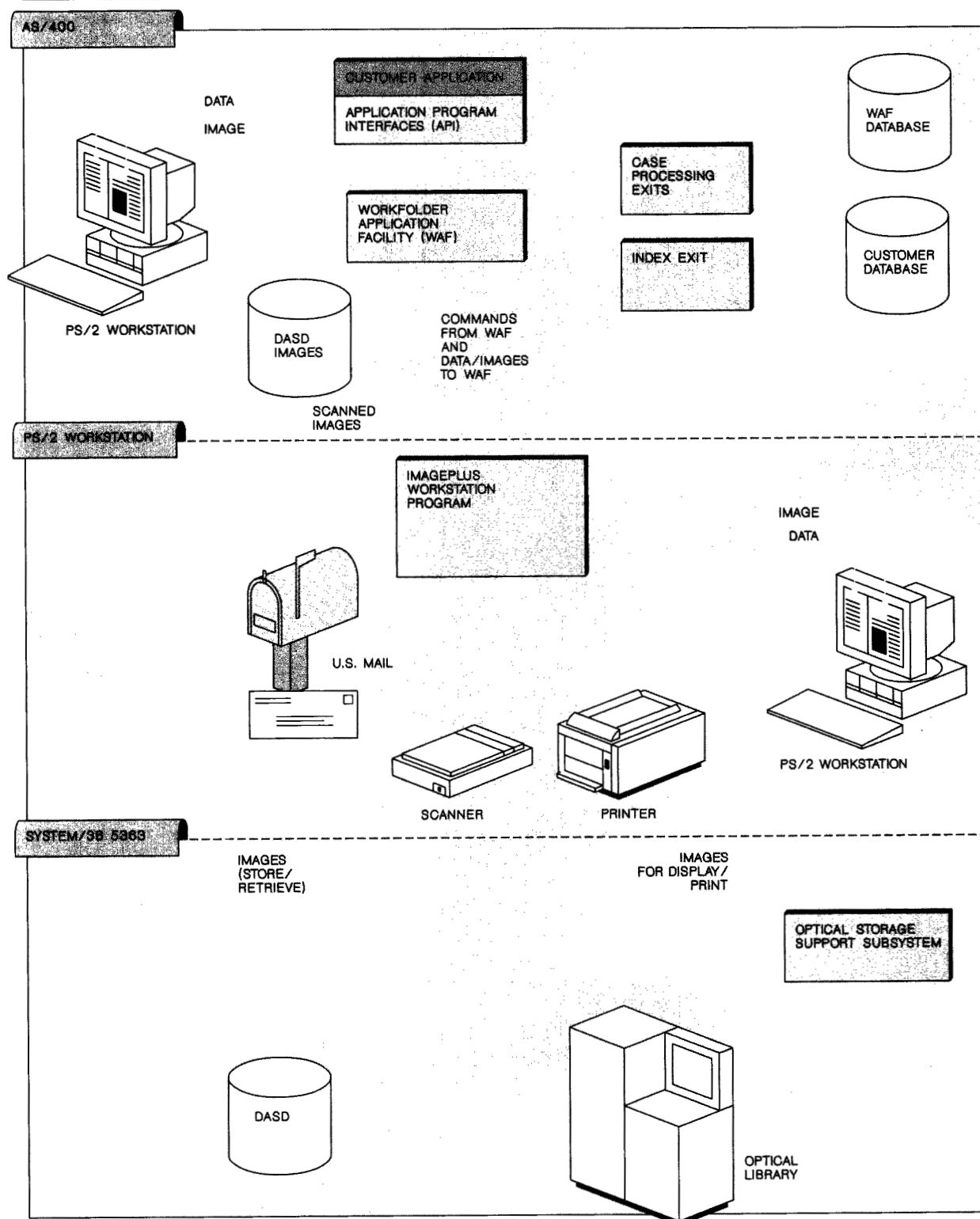
Displaying documents may be performed at any of the image workstations. When documents are requested for display, WAF sends the path address to the image workstation. The workstation program retrieves the document from the AS/400 DASD or from the optical storage library and displays it on the image monitor. The path address sent is the same as the one established at scan time.

Document storage and retrieval is performed as a background operation. A background STORE process for placing a copy of the DASD image on optical disk storage may be executed during the scanning process or may be run during an off shift. This process uses WAF-to-optical-storage interface, which is described later in this paper.

During case processing, the DASD copy of an image may be deleted. If images are required for processing, a retrieve process is provided that places a copy of the archived optical image on AS/400 DASD. In most cases, this is done through a staging process that makes the documents available for display after they have been retrieved. Occasionally, when an image processing operator requires the interactive display of an image not available on AS/400 DASD, retrieval is done directly from the image workstation software and is transparent to the operator. These retrievals, termed *ad hoc retrievals*, lengthen the response time, because time spent finding, accessing, and transmitting an image to the workstation is time that the image operator is waiting for the display request to be satisfied.

Optical Storage Support Subsystem. The Optical Storage Support Subsystem is based on the System/36 System Support Program (SSP), which is modified to allow attachment to an optical storage library and individual optical drives. The Optical Storage Support Subsystem communicates with the application environment in the AS/400, IBM PC, or IBM PS/2 system through the System/36 shared folders function. The Optical Storage Support Subsystem makes up to 128 gigabytes of on-line optical storage available to the ImagePlus system for the storage of

Figure 3 AS/400 ImagePlus processing flow



images. Optical platters that have been removed to make room for new platters continue to be managed by the Optical Storage Support Subsystem.

Hardware components of the Optical Storage Support Subsystem include the following parts. A FileNet™ Optical Storage and Retrieval (OSAR™) 64 Model 0100 Library provides 64 bins for storage of optical disk cartridges and may hold up to four optical disk drives. The library is attached to the Model 5363 via the standard System/36 5363 ASYNC adapter. The OSAR provides 128 gigabytes of optical storage to the ImagePlus system. The Laser Magnetic Storage International Company (LMSI) LaserDrive™

A single adapter can support up to seven optical drives in either a stand-alone mode or through the optical library.

1250E Optical Disk Drive is used in the optical library, and a LaserDrive 1200E Optical Disk Drive is used as the stand-alone drive. These drives can access one side of an optical platter at a time. To access the other side, the platter must be removed, rotated, and reinserted. In the OSAR, these actions are provided by robotics under the control of the Optical Storage Support Subsystem without operator intervention. The drives are attached to the 5363 through the IBM System/36 5363 Optical Disk Drive Adapter. The Optical Storage Support Subsystem allows for the configuration of up to two adapters on an IBM System/36 5363. A single adapter can support up to seven optical drives in either a stand-alone mode or through the optical library.

Optical disk cartridges used with the LMSI drives use write-once-read-many technology. The twelve-inch platters are kept inside cartridges for ease of handling; the platters are two-sided, and both sides are used by the Optical Storage Support Subsystem. Each side of an optical disk has a one-gigabyte capacity and is treated as a separate logical volume. The logical format of a platter consists of one million 1024-byte sectors. Sectors allocations are as follows:

volume label (contains volume name); subdirectory (contains path addresses of object directories); data area (contains Document Object Directory which is sector addresses of the 960 objects per directory block); and document objects.

Software architecture includes the Optical Storage Support Subsystem, which introduces the concept of a *media folder* to enable the storage and retrieval of objects on optical volumes or diskettes (media). The media folder is similar to a System/36 document folder. The difference is that the members in the media folder do not permanently reside on the System/36 disk device. They are initially written on the media folder and later copied to the specified media and then deleted from the disk. The Optical Storage Support Subsystem intercepts OPEN and CLOSE requests for members that are contained in a media folder and passes them to the media folder manager.

Media folder manager determines the status of the data object and the type of activity requested, which may be of the following three types:

- Writing an object to a media folder
- Reading an object that is not in the staging area
- Reading an object that is in the staging area

Stage manager is responsible for moving objects between an optical volume and disk device media folder. Requests generated by the stage manager are sent to a program known as the *optical function manager*.

Optical function manager initiates the I/O operations to satisfy the requests to read or write an object on the optical library. Requests are queued and sent to the *optical I/O manager*. The optical function manager maintains the operational relationships between optical volumes, library bins, and optical drives in order to check the current status of the requested optical volume. The optical function manager uses functions provided by the *media index manager* to locate an object on a specific optical disk. The media index manager and the optical I/O manager are discussed in the following two paragraphs.

Optical I/O manager converts optical I/O function requests into library and optical drive requests that are directed to the library robotics through library microcode.

Media index manager determines which optical volume contains the requested object data. The object-

to-volume correspondence is maintained in a set of tables. Two of the tables used by the media index manager are the path-volume relationship (PVR) table and the volume-to-address reference (VAR) table. The PVR maps the logical object name to its related media volume and the VAR contains the physical location of the optical volume.

Workfolder Application Facility processing

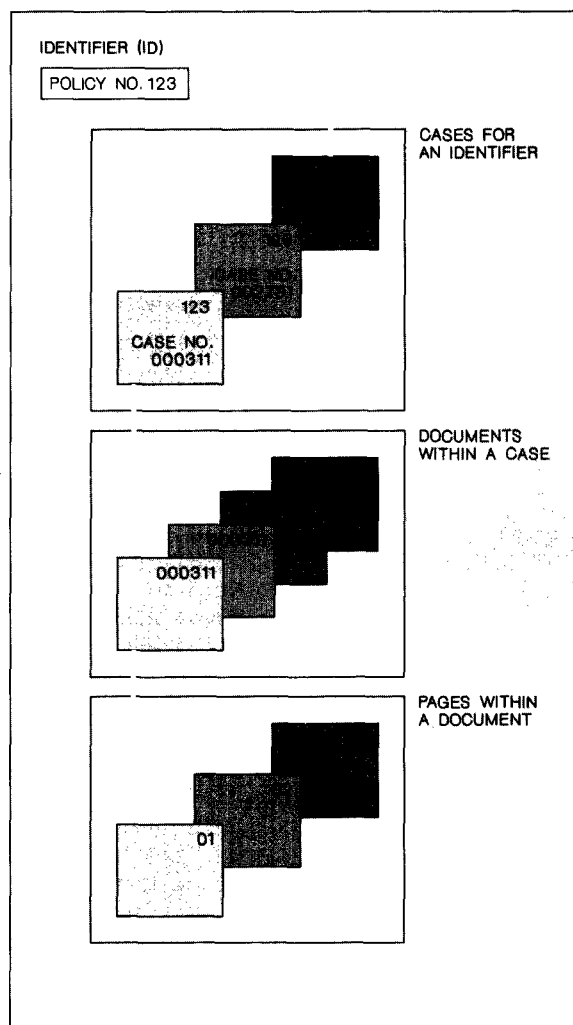
The Workfolder Application Facility (WAF) is the front-end application to the AS/400 ImagePlus system. WAF provides an easy-to-learn-and-use menu-driven user interface with extensive help facilities. WAF also provides an extensive set of user exits and application program interfaces. The WAF application initiates the scanning of documents into the system and allows the images to be viewed concurrently by the users of the system. The documents may be processed individually or placed on a work queue. The *case management* aspect of WAF provides a system of work queues that allows transactions (cases) and their associated images to be routed to individuals responsible for performing the type of work required by the transaction. WAF also provides the capability for simple document storage and retrieval. Because this is a database-driven application, WAF is highly adaptable to different user environments. A series of system and application profiles allows the user to specify:

- Document types
- Work queues
- User capabilities and authorizations
- System processors

WAF comprises six major functions. Two of these, input processing, and workfolder/case processing, provide interactive day-to-day processing. The others—administration, system services, output, and backup/recovery processing—provide the administrative and system management functions required to establish and maintain system operations.

Folder architecture. Figure 4 shows the basic WAF workfolder architecture. The term *workfolder* is synonymous with *case*, but it is used to differentiate between a transaction-oriented case and a document repository or workfolder. The case is the primary unit of work within WAF, and it represents a logical collection of documents of one or more pages related by a unique identifier. The identifier, entered during indexing, associates the case with a specific customer

Figure 4 Workfolder Application Facility (WAF) logical folder application



or account. Multiple cases may exist for any identifier. Each case is assigned a unique case ID when it is created. The case ID is used by WAF to control work flow. The case may relate to a short-lived transaction (case), or is placed in a repository for documents related to a particular customer. The mechanism that defines whether a document initiates a short-term transaction (case), or is placed in a repository for documents that are filed (workfolder), is the *document type profile*, which is described later in this paper. An example of this is an automobile insurance policy. The original application is stored in a work-

folder that remains active for the life of the policy. Occasionally new documents, such as changes to the policy, must be filed with the workfolder. When a claim is filed against the policy, that claim initiates a new case related to the policy by policy number. All the documents related directly to a claim become part of the case. The case related to the claim may be placed on a work queue and be processed through the management capabilities of WAF. When the claim is satisfied, that case is closed.

Configuration control architecture. One of the main strengths of the ImagePlus system is adaptability. Three elements of WAF provide the means to image-enable any customer environment:

- System and application profiles
- User exits that link WAF to customer applications
- Application program interfaces (APIs) that allow access to image function

User exits and APIs are discussed in a later section. The key to adapting WAF to the customer environment is the WAF profiles, which are a series of tables completed by the customer during system installation that allow the customer to define the processing characteristics and system configuration to WAF. WAF profiles are created and maintained through a screen-driven interface and may be updated at any time. Figure 5 shows examples of the user ID profile and the document type profile.

User profiles make it possible for each user to be identified to WAF by creating a profile that contains the user ID. The user profile describes to WAF the functions available to that user, and allows WAF to restrict user access to queues, document types, and specific functions.

Document profiles identify and describe each type of document and the rules for the management and usage of each document type. When new documents are scanned into the system by WAF, they are always assigned a document type. Based on the document type, WAF can make the following types of decisions:

- When a document is indexed, should a new case be created or should it be inserted into an existing case? For example, a loan application form may always create a case, but an appraisal form should always be inserted into an existing case.
- Should a document be stored on an optical medium?
- How many days should this document stay on DASD if the folder containing it is inactive?

- Can the user PEND a case for a particular document type? (PEND is an action to suspend.)
- If a case is in a PEND state for this document type, should WAF remove the documents in the case from DASD, while it waits for the incoming document?
- Which users can view documents of a particular type?
- If a new case is created, should that case be queued for work? If so, what should be the default queue?

Queue profiles define valid WAF work queues. Queues are of two types: (1) general queues, which are shared and can be accessed by anyone having access to a given queue class; and (2) user queues, which are specific to and accessible only by a specific user. The queue profile also allows for an alternate queue, whereby the systems administrator or manager can reroute work from a queue of someone who is sick or on vacation into another queue.

Processor profiles define each CPU in an ImagePlus configuration. The AS/400 ImagePlus system is a multiple processor. A single ImagePlus configuration supports up to six processors. The six CPUs may be a mix of AS/400 and 5363 and optical library processors. The profile defines the processor ID for each of the attached processors. The processor ID forms the drive ID portion of the path address for images and allows each processor to be accessed by a PS/2 workstation. In addition, the profile record indicates to WAF whether a particular AS/400 processor is the primary system containing the WAF databases.

Optical profile identifies the optical subsystem(s) in an ImagePlus configuration. It also defines the processor ID of the optical subsystem and allows the workstations to have direct access to the documents stored on optical disk.

Folder profiles identify the AS/400 system shared folders that are to be used for storage of image documents. These storage locations are used by WAF as access paths to the documents. An access path is really a PS/2 directory name and subdirectory name. This path and the document name is sent to the image workstation when documents are written during scanning or read during displaying and printing. The actual folders are created using AS/400 shared folder utilities.

Input processing. To become an ImagePlus document, a paper document must be scanned and then indexed into the WAF application. Each document

Figure 5 Examples of Workfolder Application Facility (WAF) profile maintenance menus

```

EKD330201          Document type profile

Status: ADD/UPDATE

Type information, press Enter.
Document type . . . . . _____
Description . . . . . _____
Maximum days pended . . . . . _____ 1-999
DASD storage control . . . . . _____ Y=Yes, N=No
Store on optical . . . . . _____ Y=Yes, N=No
Output required . . . . . _____ Y=Yes, N=No
Output form ID . . . . . _____ ID
Add to pend list . . . . . _____ Y=Yes, N=No
Create new case . . . . . _____ 1=Yes, 2=No, 3=Both
Allow scan and index . . . . . _____ Y=Yes, N=No
Allow pending . . . . . _____ Y=Yes, N=No
Default queue ID . . . . . _____ ID
Batch size . . . . . _____ Number (1-9999)
Require pend data . . . . . _____ Y=Yes, N=No
Days stored on DASD . . . . . _____ 1-999
Security class . . . . . _____ 0-999

F1=Help    F3=Exit    F5=Refresh
F7=Previous document  F8=Next document  F12=Cancel  F16=Delete
type              type
  
```

```

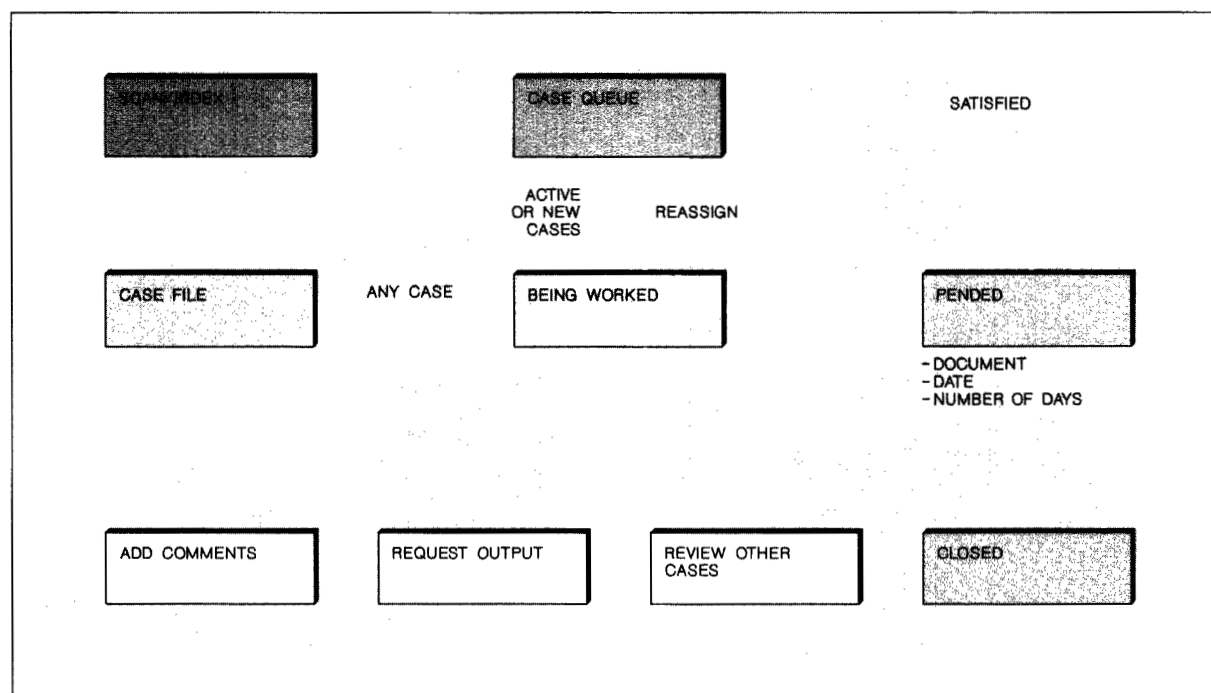
EKD33501          User ID profile

Status: ADD/UPDATE

Type information, press Enter.
User ID . . . . . _____
Name . . . . . _____
Queue classes . . . . . _____ 0-999
Queue class range . . . . . _____ to _____ 0-999
Security class range . . . . . _____ to _____ 0-999
Allow indexing . . . . . _____ Y=Yes, N=No
Allow scanning . . . . . _____ Y=Yes, N=No
Allow case processing . . . . . _____ Y=Yes, N=No
Allow exit from case work . . . . . _____ Y=Yes, N=No
Allow working any case . . . . . _____ Y=Yes, N=No
Allow removing documents . . . . . _____ Y=Yes, N=No
Allow deleting cases . . . . . _____ Y=Yes, N=No
Allow moving documents . . . . . _____ Y=Yes, N=No
Allow copying documents . . . . . _____ Y=Yes, N=No
On-demand print queue ID . . . . . _____ Print queue
Host transaction ID . . . . . _____ ID
Department . . . . . _____ Name
Region . . . . . _____ Name

F1=Help    F3=Exit    F5=Refresh
F7=Previous user  F8=Next user  F12=Cancel  F16=Delete
  
```

Figure 6 Case folder processing flow



scanned must be accompanied by an identifier and must be one of predefined document types. The identifier must be known to the customer's line-of-business application, if one exists. This identifier is used as the primary index into the WAF application. Each case in WAF must relate to a specific identifier. Indexing uses an identifier (Social Security number, claim number, invoice number, account number, etc.) that is keyed by the scanner. The identifier is used to process the document according to the rules for the type of document being indexed. Document types are established by the customer at installation and are maintained in a document type profile. Indexing follows one of the following three rules for indexing documents:

- Begin a new case (type 1).
- Insert the document in an already established case for that identifier (type 2).
- Insert a document into a case if one exists for that identifier; if none exists, create a new case (type 3).

Indexing places a case on a work queue as an active case if a queue identifier is supplied by the indexing operator. If no queue identifier is provided, the case is filed as an open workfolder.

During case processing, it may be necessary to PENDING a case by setting it aside while waiting for an event or for a document to allow processing to be completed. When a type 2 or type 3 document is indexed and such a document satisfies a PENDING requirement, it is merged with the case and the case is queued to the image operator who is waiting for the PENDING requirement to be satisfied.

The *create empty case* function of WAF allows a case to be created when no documents exist to be scanned. The capability also exists to add a pre-scanned form to the case interactively. This form may also be completed on line by keying data that are stored in the case and then merged with the image when the document is to be displayed or printed.

A series of user exits available during indexing allow the following actions:

- Determination of the proper identifier by a customer application
- Validation of the identifier
- Addition of user-defined keys
- Importing of line-of-business data into the WAF database

Workfolder and case processing. WAF functions in two modes: (1) the *case-processing mode*, in which documents scanned and indexed into the system are associated with active cases and placed on a work queue for processing immediately; and (2) the *electronic folder storage and retrieval mode*, in which documents are filed in workfolders being maintained in an open status for access on demand. The latter are referred to as workfolders to distinguish them from the short-term transactions that are represented by the term case. Figure 6 shows the flow of work through WAF workfolder and case processing. Workfolders and cases are selected for processing by an image operator either by selecting a queue (case-processing mode) or by selecting a specific workfolder (electronic folder-storage and retrieval mode). After being selected as being worked, the workfolder and case are not available to be worked by other image operators.

When a case or workfolder is selected for processing, a screen is presented that lists all the documents that the image operator is authorized to see. Figure 7 depicts the screen presented to the image case worker. Using the numbered document-related options or the PF-key case-related options, the image

operator may select one or more of the documents for display and perform the action required by the line of business (LOB). A separate session may be available in which the operator accesses an LOB database, either on the same AS/400 or on some remote system, where transactions are performed, based on the documents in the case.

For example, the image document may be a letter from a customer requesting an action be taken on the customer's account. The image operator, using a designated "hot key," may switch to another workstation session on which to access the customer's account in the LOB database. There the operator determines whether sufficient information exists to resolve the problem. If there are insufficient data, the image operator may PEND (suspend) the case, awaiting a specific document or for some amount of time to elapse. In a PEND state, the case is removed from the image operator's queue and placed on a PEND list. When the required document arrives, it is scanned and matched against the PEND cases. If matched, the case is automatically reactivated and placed back on the queue designated when the PEND action on the case took place. The image operator may then complete the requested action and CLOSE

Figure 7 Case folder processing screen

```

EKD20203          Work with queued case documents

Identifier . . . . . : xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Case ID . . . . . : xxxxxxxx
Case status . . . . . : x
Case description . . : xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Queue description . . : xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

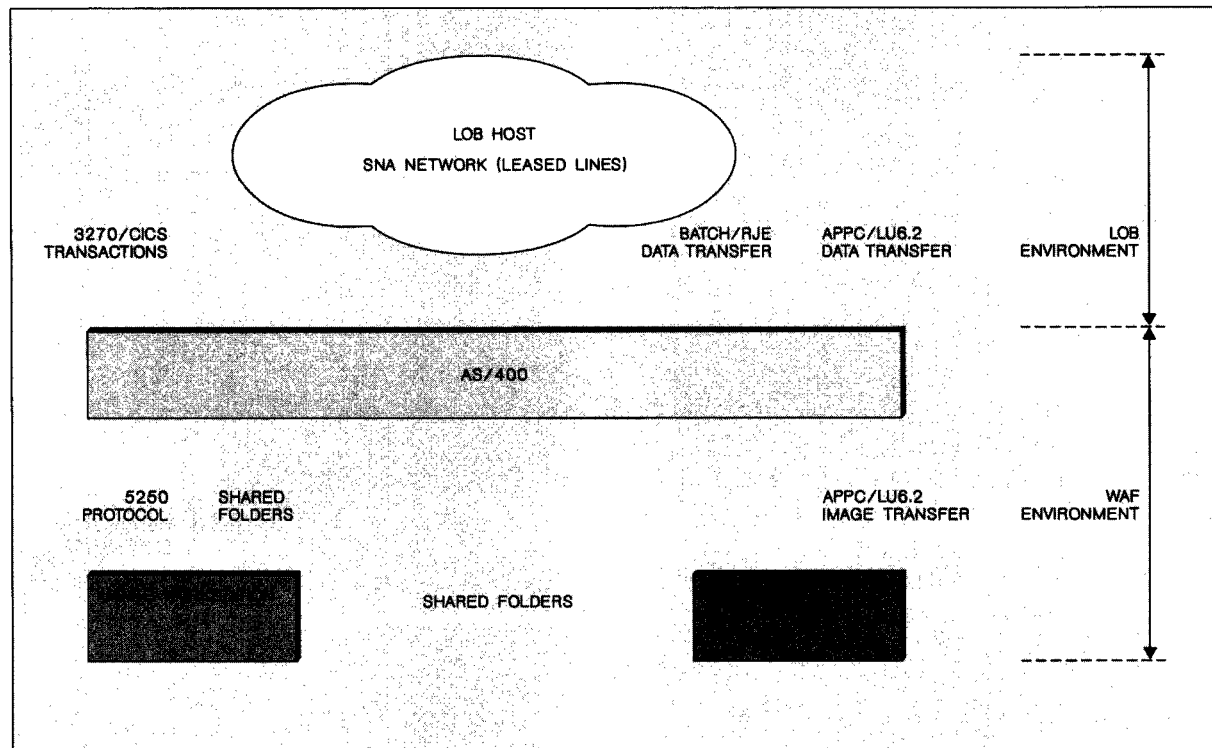
Type option, press Enter.
    2=Move  3=Copy  4=Delete  5=Display  6=Print  8=Reindex

    Document
Option type  Description      Scan date  Pages  Storage
-           -               -          -      location
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x
-   xxxxxxx  xxxxxxxxxxxxxxxx  xxxxxxxx  xxx    x

More...

F1=Help      F2=Pend  F3=Exit  F4=Display all  F6=Batch print
F7=Reassign  F8=Review cases  F9=Close      F24=More keys
  
```

Figure 8 ImagePlus interconnections



the case. A REASSIGN function exists to allow cases placed in the wrong queue to be assigned properly. This function also allows an image operator to ask a question of a supervisor by placing the question in the comments for the case and reassigning it to the supervisor by the REASSIGN command. The supervisor, in turn, answers the question via the case comments and retransmits the case back to the image operator via REASSIGN. The flexibility of WAF allows a broad range of workfolder processing applications to be implemented.

Output processing. During the course of processing, an image operator may request the printing of a document or a case through the DEMAND-PRINT BATCH-PRINT functions.

The DEMAND-PRINT option is used to print individual documents whenever required in the work-flow process. DEMAND-PRINT requests are placed in the queue specified in the image operator's user ID profile and routed to a specific printer when the DEMAND-PRINT processor is started.

The BATCH-PRINT function allows complete cases to be printed. The image operator may specify which documents are to be printed, and the operator must also select a prescanned form to be printed, preceding the selected case. The form may include system data such as date and coded data (entered at the time of the print request) and/or data from the WAF user data file. The predesigned form (stored as an image) and the coded data (stored as a Presentation Text Object Content Architecture—PTOCA—record) are merged at print time and the data stored in the folder for that identifier. Batch print requests must be preprocessed, creating print spools that are selected for printing on one of the dedicated print workstations.

Interfaces. As depicted in Figure 8, the AS/400 ImagePlus system is made up of several components, including the following:

- AS/400 standard hardware and software
- Optical Storage Subsystem
- Image workstation and the ImagePlus Workstation Program

- **Workfolder Application Facility (WAF)**

The IBM Token-Ring Network is the means of communication between the ImagePlus components. PC Support is the vehicle for communication and is installed on the AS/400, the ImagePlus workstations, and the System/36 5363 (using AS/400 PC Support/36 Coexistence). The workstations communicate to the AS/400 via the AS/400 router and pass through the AS/400 using Advanced Program-to-Program Communication and Advanced Peer-to Peer Networking (APPC/APPN) support to the 5363. The WAF store and retrieve processes use APPC to communicate between the AS/400 and the 5363. The following paragraphs describe the interfaces between the ImagePlus components.

WAF to image workstation interface. When an ImagePlus workstation undergoes IPL, it first starts DOS and standard PC Support communications. This includes the following: starting APPC communications via the PC Support router; starting shared folders sessions (virtual PC drives); and starting the AS/400 terminal emulator (workstation function) that provides the AS/400 terminal sessions for the user. After all these functions have started, the ImagePlus Workstation Program starts and becomes the PC DOS program. The ImagePlus Workstation Program then goes into a wait state, waiting to receive commands. The ImagePlus Workstation Program functions only in response to commands from WAF as a result of a menu request or via the application program interfaces (APIs). The user would then HOTKEY to the AS/400 terminal session, sign-on to the AS/400, and start the WAF. When WAF is executing—in response to end-user menu selections—it sends commands to the the ImagePlus Workstation Program via a special command interface. When a command is received, the ImagePlus Workstation Program takes control of the workstation, executes the command and sends a response back to WAF.

The WAF-to-workstation interface includes the following commands:

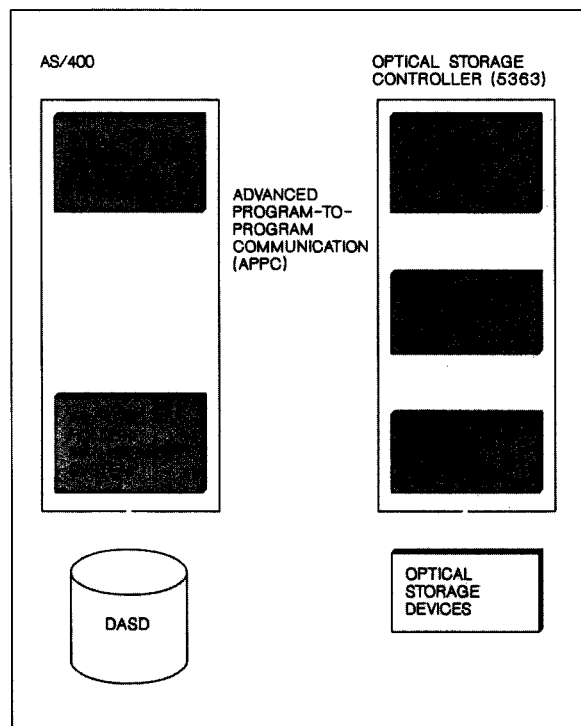
- **SCAN**—Causes the ImagePlus Workstation Program to scan a document and store it on the AS/400.
- **DISPLAY**—Causes the ImagePlus Workstation Program to display a document from the AS/400 or the optical subsystem.
- **PRINT**—Causes the ImagePlus Workstation Program to print a document from the AS/400 or the optical subsystem.
- **RESET**—Deletes the current set of image documents from the workstation.
- **KEYS**—Keystrokes the second user terminal session (LOB host session)
- **SET CONFIGURATION**—Defines a number of parameters that are required to control scanning or printing.

These commands provide all of the image workstation processing functions for WAF. WAF is always in control, with the workstation as a slave request processor.

Image workstation to LOB application interface. AS/400 PC Support allows five sessions on the ImagePlus workstation. The user switches between these sessions through the use of the hot key, Alt-Esc. Session 1 is designated as the WAF session; session 3 is the image session. Session 2 is the host session, which may be used to communicate with the user's LOB application. This application may be coresident in the AS/400, in a remote AS/400, or in another mainframe, such as the System/370. The emulation of a 3270 from the AS/400 may be used to communicate with the remote location. Sessions 4 and 5 may also be used for user applications. Any AS/400 or mainframe session may be started from these sessions. PC applications may be started only if the the image workstation program software is terminated first.

Image workstation to AS/400 shared-folders interface. The commands that provide the interface between the ImagePlus Workstation Program and the WAF use document paths and document names. Consider the example in which the WAF sends a SCAN command to the ImagePlus Workstation Program and tells the ImagePlus Workstation Program that the path for the scanned document is D:\FOLDER01\WAFSBDIR.001\ and that the document name is A3891101.001. The ImagePlus Workstation Program then processes the scan command and stores the document under the specified name in the specified location using standard DOS calls (interrupt 21). The interface used to store the documents on the AS/400 DASD is PC Support shared folders. PC Support device drivers trap the DOS calls and transfer the documents into AS/400 system folders. The shared-folders interface provides shared access to all documents on the AS/400, thereby allowing the workstations to access up to 36 gigabytes of DASD. In addition, the shared-folders interface on the optical subsystem provides access to all the documents stored on optical disk, which could be of the order

Figure 9 Optical subsystem interface



of magnitude of terabytes. Errors in accessing objects through shared folders are passed back to WAF via the command interface.

WAF to Optical Storage Subsystem interface. To facilitate the storing of documents on the Optical Storage Subsystem, after they have been written to DASD by the ImagePlus Workstation Program and the retrieving of documents back to DASD from the optical subsystem, a requestor/server interface was developed between WAF and the 5363 optical controller. This interface is shown in Figure 9.

The request processors are WAF programs which run on the AS/400 and use APPC to send the documents to the 5363 Optical Storage Support. The WAF has one request processor for storing documents, the optical library store program, and one for retrieving documents back to DASD, the optical library retrieve program. The store and retrieve requests are created by various components of WAF. For example, when a document is scanned and stored, WAF creates a store request, and, when a case is closed, a delete request is generated for the documents of the case.

The request processes evoke the optical server programs that run on the 5363 Optical Storage Support using APPC commands. One server program is responsible for creating new optical media folders, and another creates documents in the media folders and retrieves the documents from the media folders. The Optical Storage Support software actually writes the documents on the optical platters.

WAF external interfaces. The key to a successful image processing product is its ability to integrate with the application systems that support the current business process. The replacement of paper by an automated image system can greatly enhance the current data system by electronically tying actual documents with the line-of-business records.

AS/400 ImagePlus provides two methods to facilitate this integration: (1) Workfolder Application Facility exits and (2) application program interfaces. The exits are user-written routines that are called by WAF at selected points in the WAF process, such as when a document is scanned and indexed. Application program interfaces are subroutines that user applications can call to provide image and document-handling functions to the actual user line-of-business application. An example of this is the display of the invoice document that corresponds to a specific purchase order.

WAF provides nine exits that may be called when the user causes particular functions of WAF to be executed. WAF passes a set of parameters to the user exit and expects a set of parameters returned. The nine WAF user exits provide the following capabilities:

- A create-identifier exit, which passes the value entered by the scanner/indexer to the user program, and allows the user program to return an identifier to be used to index the document
- A start/stop-indexing exit, which allows the user to establish or release communication paths to a host application for document indexing
- A create-case exit, which allows the user to validate the identifier that was keyed by the indexing operator, create additional index fields, and add information associated with the identifier to a user file in the WAF database. This exit is called for those document types that cause a new case to be created.
- A batch create-case exit, which provides the same function as the previous exit but communicates with a version of the indexing program that runs in the background

- An insert-document exit, which allows the user to validate the index keyed, create additional indexes, and determine to which queue a case should be assigned. This exit is called for document types that will be merged with existing cases.
- A search-case exit, which allows the user application to determine the case that should be displayed. This exit is used in conjunction with the create-case exit that creates the user indices.
- Three function-key exits, which allow the operator to access user-written applications while processing WAF cases

In many application scenarios, the current line-of-business applications can be image-enabled, while shielding the user from WAF screens. The application may already have a work-processing system or a document indexing system that simply needs access to image functions. To facilitate this, WAF provides workstation application program interfaces (APIs). These APIs provide the interface to the image workstation, the optical subsystem, and the WAF folder management. The API commands are the following:

- SETC sends the workstation configuration command.
- SCAN sends the workstation scan command.
- SENDOBJ sends the workstation display command.
- RESET sends the workstation reset command.
- PPRTOBJ sends the workstation print command.
- PRINTOBJ puts a print request on the demand print queue.

The storage management API commands are as follows:

- STOROBJ creates an optical store request.
- FETCHOBJ creates an optical retrieve request.
- DLTEOBJ creates a DASD delete request.

The folder-management API commands are the following:

- INDEXOBJ indexes a document.
- DEFFOLD creates a case.
- DEFSTOBJ adds a document to a case.
- RMVOBJ removes a document from a case.
- FINDOBJ lists documents in a case.
- CRTOBJ creates a new document record.

Concluding remarks

The ImagePlus system has demonstrated in live, full-production environments that it is possible to man-

age the large quantities of visual information not currently handled by existing systems. ImagePlus has succeeded in capturing the vast amount of visual information used in business processes and presenting it in a familiar and controlled manner. This allows the application of standard database and information processing techniques.

The AS/400 ImagePlus system is built on existing IBM architectures and products. The SNA communications architecture and the document-content and PS/2 architectures provide the building blocks. The AS/400 PC Support and folder-management functions provide the backbone to tie new capabilities together. The new Workfolder Application Facility (WAF) and ImagePlus Workstation Program products provide powerful new tools that allow enterprises to remove paper from their desk tops and move the document images quickly from place to place. The benefits derived from applying ImagePlus include the reduction in labor dedicated to paper handling, distribution, filing, and retrieval. Improved system responsiveness is a result of shorter processing cycles. Other benefits are reduced storage costs and improved availability and control of documents. There are no lost or misfiled papers. At the same time, more than one user may have access to a single document on a rapid-retrieval basis. At all times there is computerized document control. The system has greater capacity or storage density than paper, which results in cost avoidance in the long run.

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prototype for the Workfolder Application Facility and is continuing to support the further development of midrange ImagePlus products. Mr. Mullen continues to work in the areas of planning and development of midrange ImagePlus products.

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